US006494635B1

(12) **United States Patent**
Merlo

(10) **Patent No.: US 6,494,635 B1**
(45) **Date of Patent: *Dec. 17, 2002**

(54) **JOINT MECHANISM**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/649,039**

(22) Filed: **Aug. 29, 2000**

Related U.S. Application Data

(63) Continuation of application No. 09/068,003, filed as application No. PCT/EP95/04311 on Nov. 3, 1995, now Pat. No. 6,109,815.

(51) **Int. Cl.**[7] **F16C 11/06**
(52) **U.S. Cl.** **403/90**; 403/103; 403/84; 403/124
(58) **Field of Search** 403/90, 83, 84, 403/92, 93, 97, 103, 124, 128, 122, 125; 135/21

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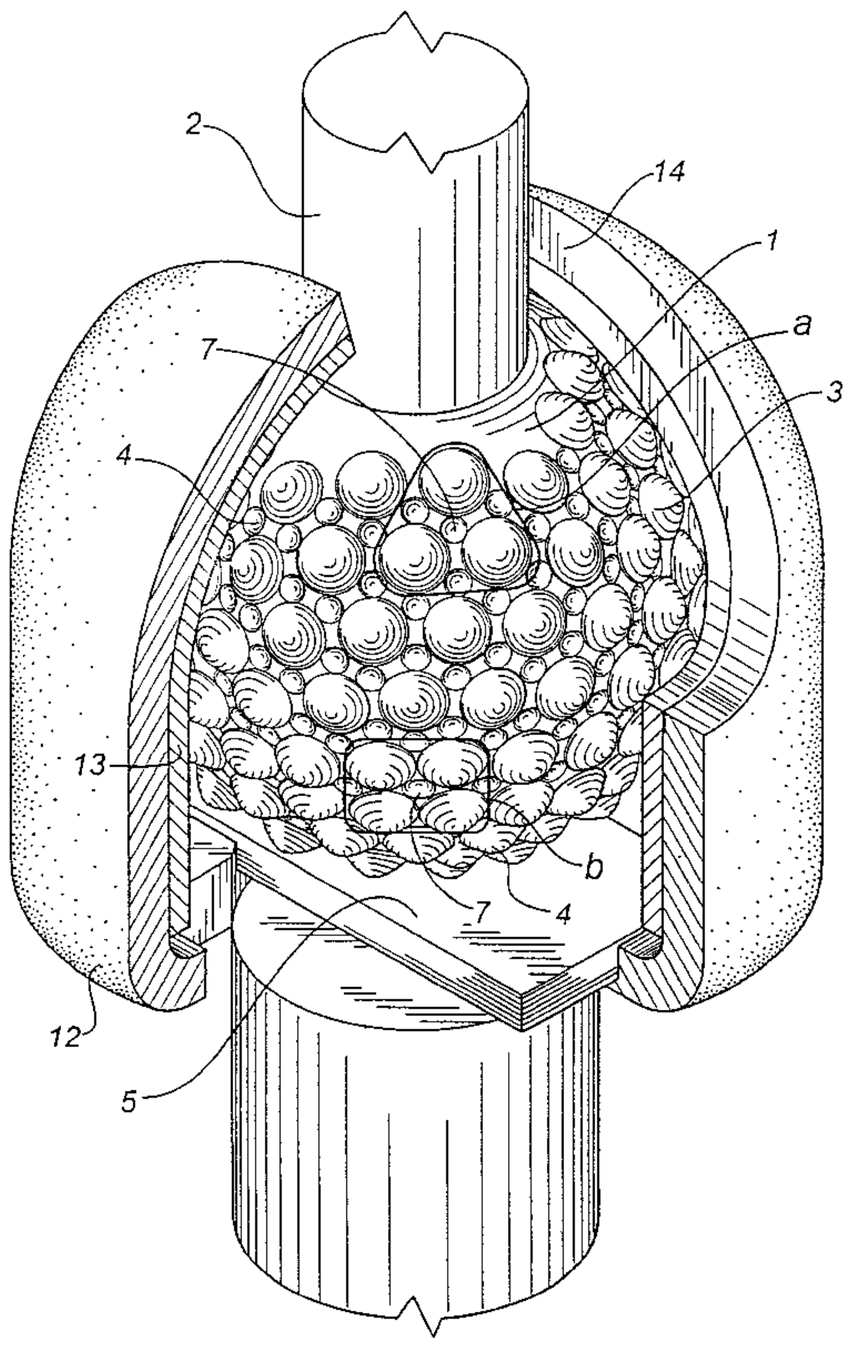
(57) **ABSTRACT**

In an angularly adjustable, releasably lockable ball joint, the ball has a surface covered with polygonal patterns of spaced apart protuberances, the protuberances defining concavities. An actuator tip is provided to penetrate at least one concavity and simultaneously contact the protuberances in the pattern to lock the ball and actuator together, thereby fixing the orientation of shanks attached to the ball and actuator.

7 Claims, 6 Drawing Sheets



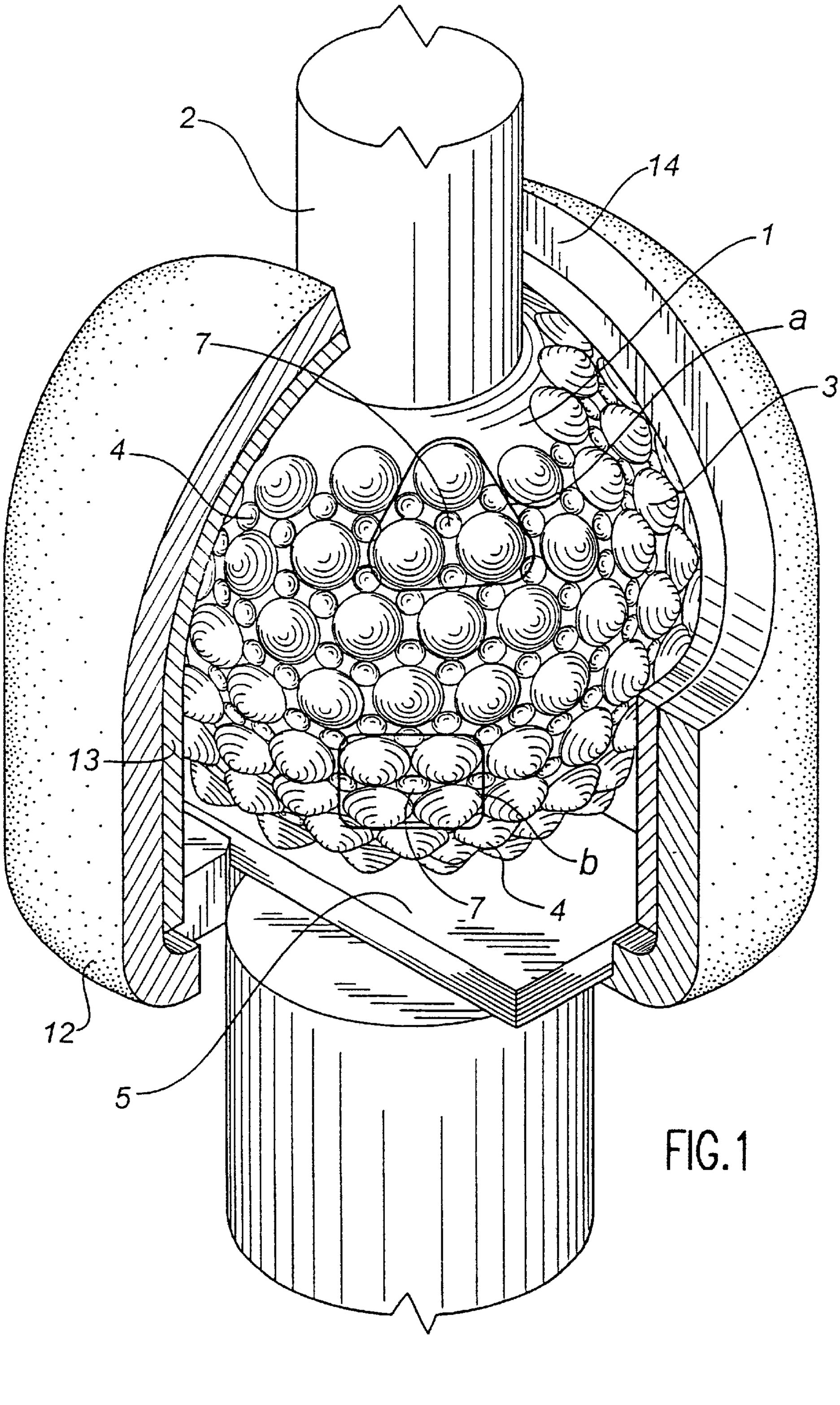


FIG.1

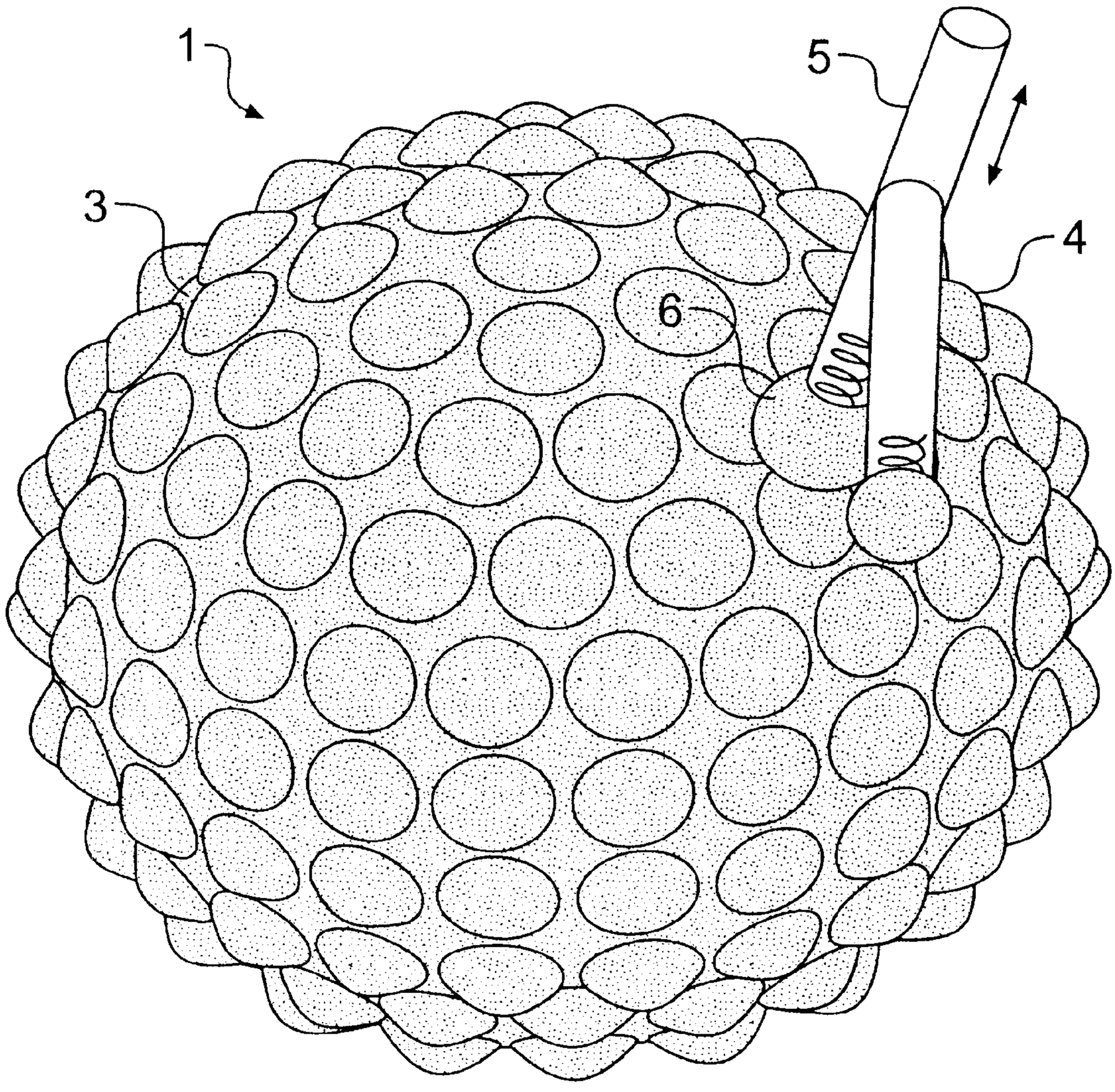


FIG. 2

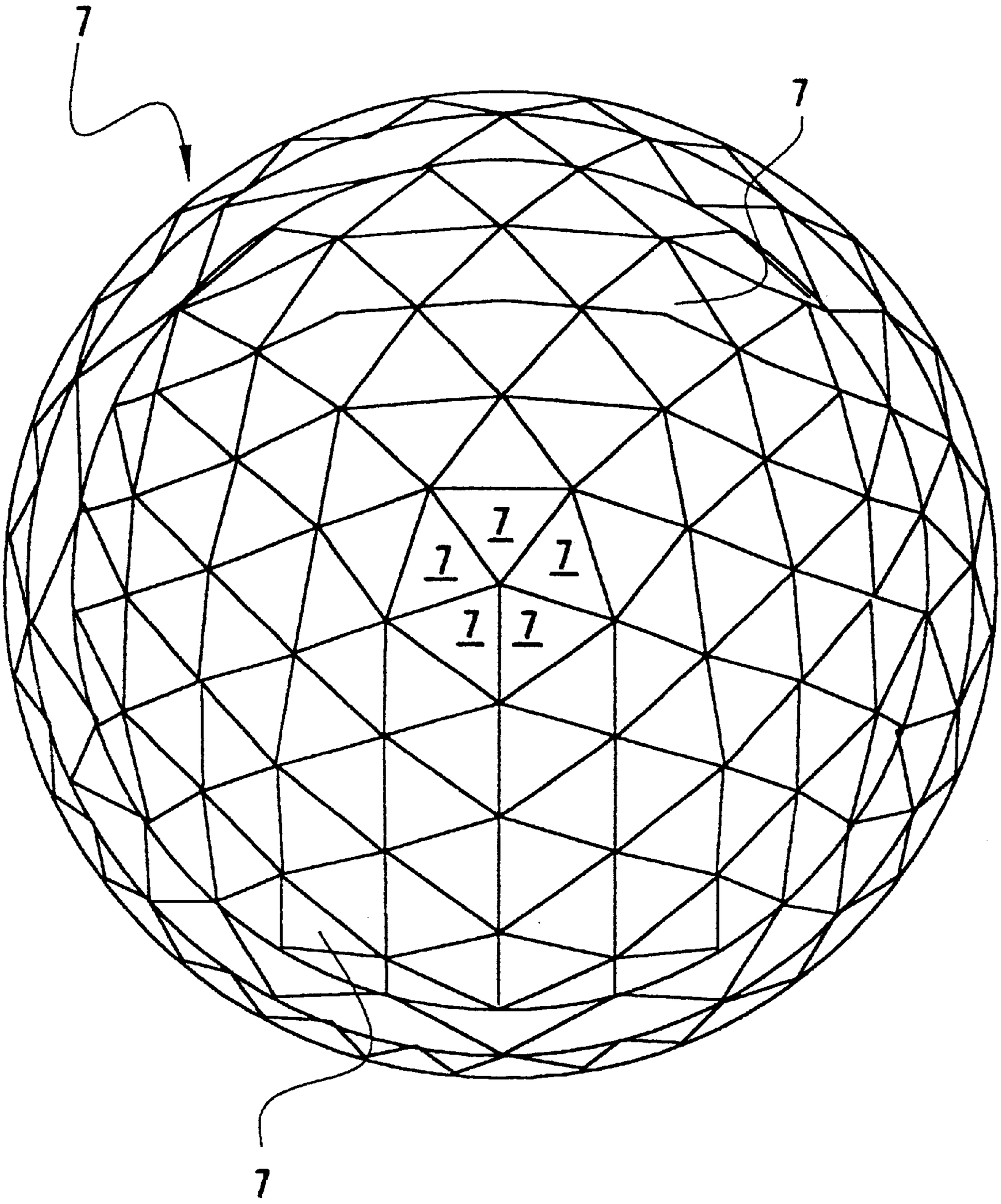


FIG.3

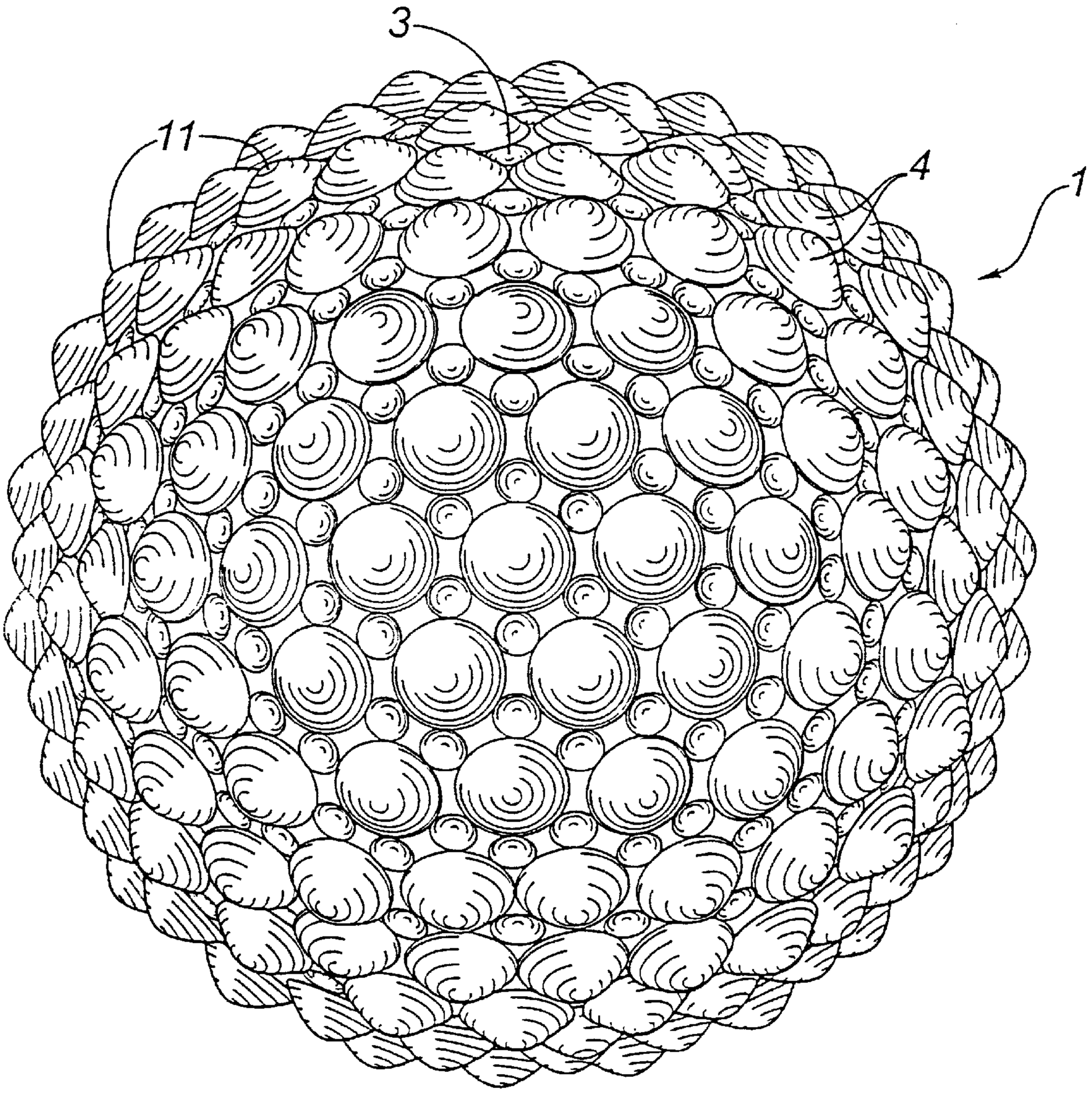


FIG.4

FIG.5

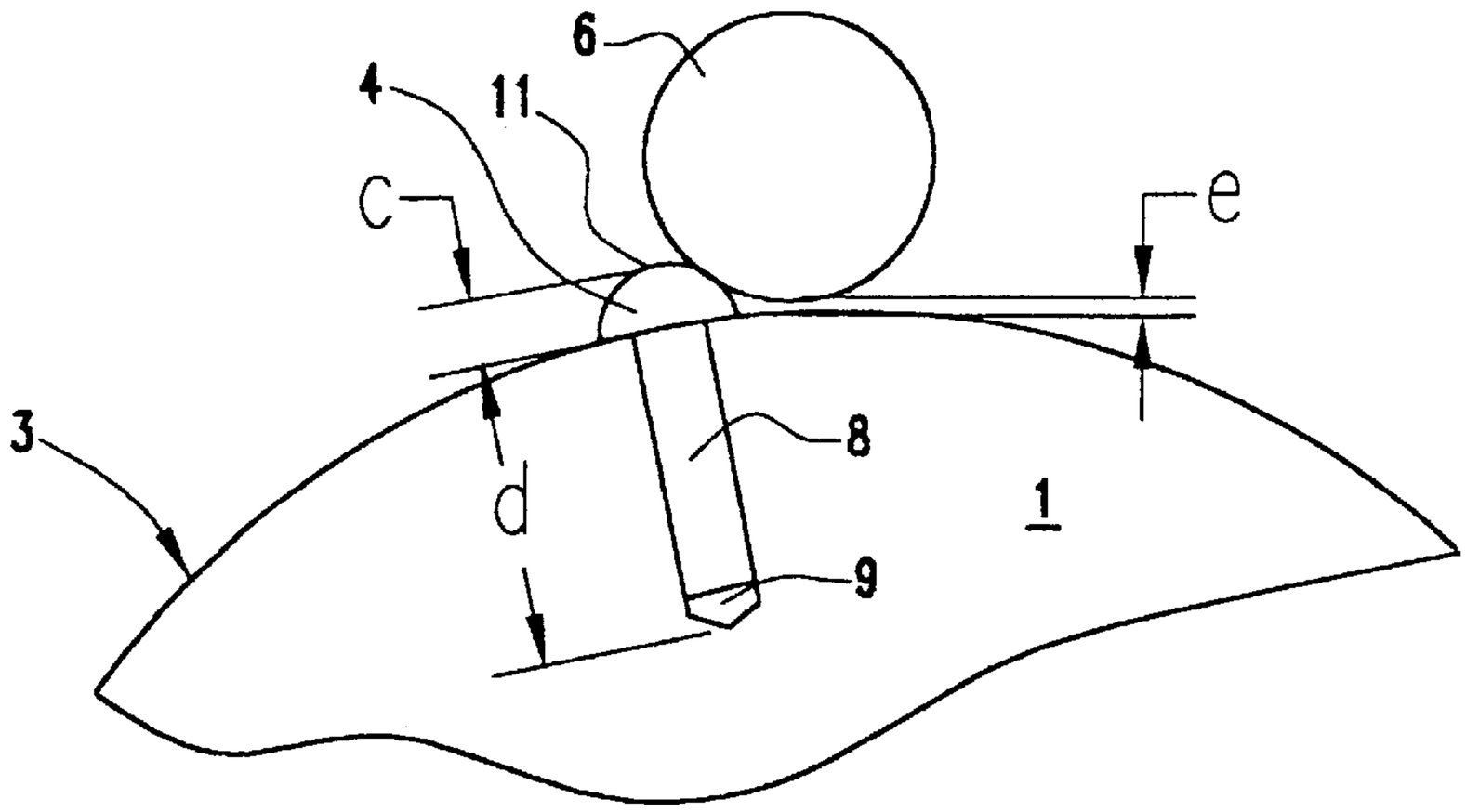


FIG.6

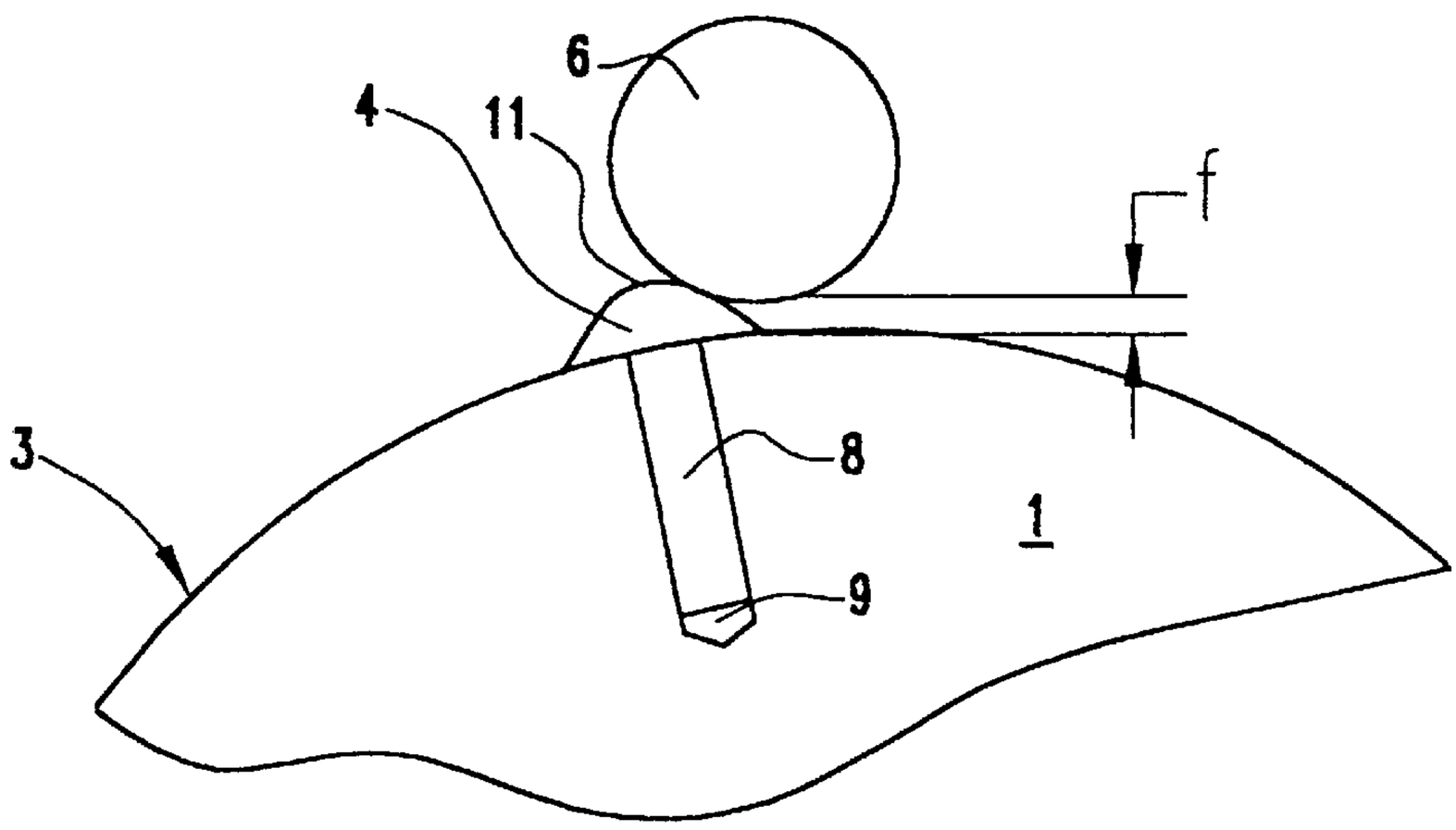
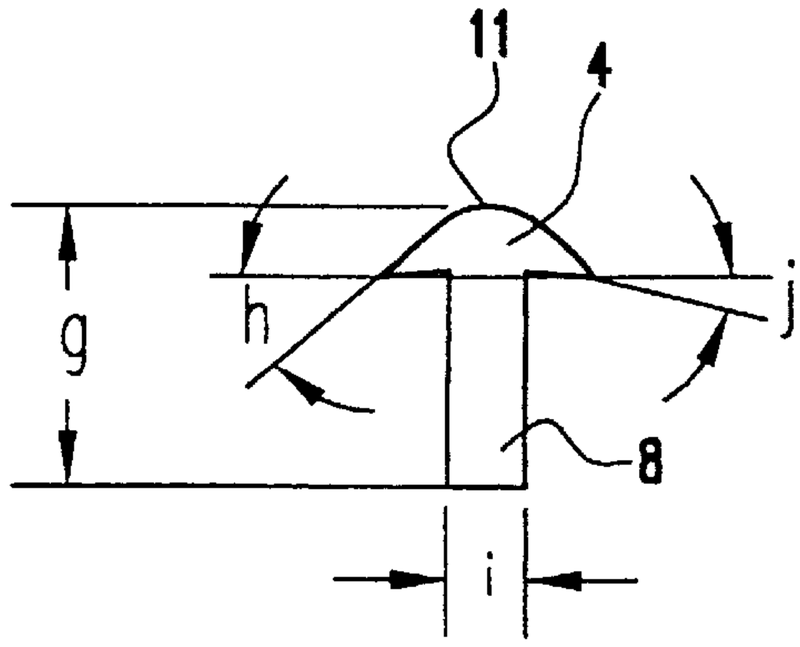


FIG.7



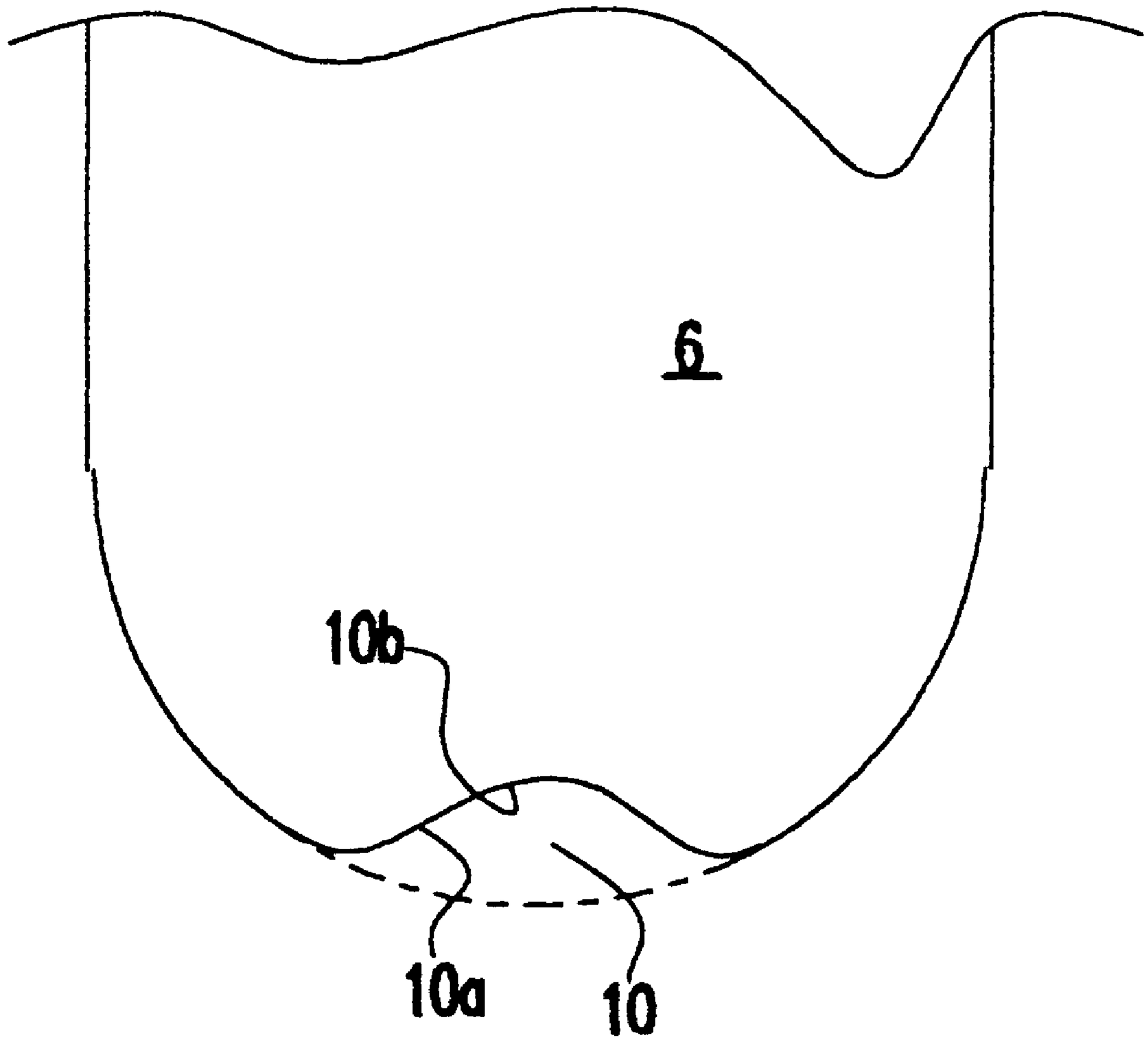


FIG.8

JOINT MECHANISM

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 09/068,003, filed Aug. 28, 1998, now U.S. Pat. No. 6,109,815 which is a 371 of PCT/EP95/04311, filed Nov. 3, 1995.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention generally relates to an angularly adjustable releasably lockable joint mechanism for rigidly joining first and second parts at a selected orientation, and more particularly to an angularly adjustable releasably lockable joint mechanism having a plurality of patterned protuberances forming concavities so that a tip of actuator can engage and disengage therefrom.

Such a joint mechanism is disclosed for example in U.S. Pat. No. 5,280,871. A movable rod has a ball fixed at its bottom, and the ball is provided with a plurality of holes orderly and equally spaced apart in the surface for the functional end of a locating pin of a supporter to selectably engage one of them to keep the movable rod secured in an angle needed. Such a dimpled ball and an actuator having a spherical tip are also shown in U.S. Pat. No. 3,433,510. U.S. Pat. Nos. 3,841,769 and 4,620,813 show a socket having protuberances and a ball having dimples or indentations which engage to fix the orientation of the arms attached thereto. U.S. Pat. No. 3,691,788 shows a ball having a grooved surface and an actuator having a spherical tip which locks up by engaging a groove. U.S. Pat. No. 892,105 shows a ball and socket whose surfaces are both knurled.

Angularly adjustable, releasably lockable ball joints are commonly used as part of an umbrella assembly, to hold a suspended canopy locked at an angle to horizontal. Assemblies of this type are shown in U.S. Pat. Nos. 4,674,523 and 5,002,081. In general, these prior art ball joints involve:

- a ball attached to a shank forming part of the suspension stand;
- an actuator or screw spindle carrying the canopy;
- a housing engaging the ball and spindle so that they cannot separate, but which is operative to enable the spindle to be angularly adjusted when the actuator is disengaged; and
- a concave socket or pin at the end of the spindle, for frictionally engaging the ball to lock the spindle and ball together and fix the canopy at a desired angle.

BACKGROUND DESCRIPTION

The frictional engagement of ball and socket as well as a dimpled ball and spherical pin actuator have been found to be insufficient when subjected to high torsional forces.

SUMMARY OF THE INVENTION

One objective of the invention is therefore to modify the joint mechanism described above to provide a stronger locking action between the actuator and the rounded member.

In combination with the features of the joint mechanism described above, the invention is characterized in that

- the rounded member having a plurality of patterns of spaced-apart protuberances covering at least part of its surface, the protuberances of each pattern forming a concavity therebetween;
- the patterns, and protuberances being mainly consistent in shape, area and size, the effective patterns having a regular polygonal configuration;
- the protuberances, actuator tip and pattern being dimensioned so that the tip can penetrate the concavity of each pattern and simultaneously contacts all of the protuberances of the pattern that it penetrates but remains spaced from the bottom of the concavity at full penetration, whereby the tip and pattern of protuberances lock together.

The invention has the following advantages:

- the locking capability is greater than one obtains with a dimpled ball;
- by arranging the patterns in accordance with a geometric design, the longitude and latitude of the concavity sites is predictable;
- the use of the triangular pattern yields a large number of concavity sites in the case of a rounded member that is spherical and of given diameter. Compared to an equivalent pattern of dimples, twice as many concavity sites result simply through the formation of the protuberances in place of the dimples; and
- it is possible to address and achieve locking at each individual position by electronic means, since all of the concavity sites or locking positions are mathematically definable.

The rounded member may be spherical and could be defined by a ball.

The invention refers to an angularly adjustable, releasably lockable joint mechanism for rigidly joining first and second parts at a selected orientation, said mechanism comprising a rounded member having a plurality of concavities on its surface and being secured to the first part, a disengageable actuator having at least one tip and being operative to advance the tip to lock up with the rounded member by penetrating at least one concavity or to retract the tip to disengage it from the rounded member, said actuator being connected with the second part, and means for holding the parts, rounded member and actuator together, said means being operative to allow the parts to change relative orientation when the actuator tip is retracted.

This mechanism is particularly adapted for use with angularly adjustable, locking devices subject to high torsional forces.

The invention comprises patterns of three and four protuberances as well as any polygons of more than four protuberances. But complete locking could also be achieved between just two protuberances and one actuator: In this case the rounded member is defined by two smooth semi-spherical halves joined in the middle by a narrow sometimes recessed surface in the middle. This recessed surface is fitted with continuous half round protuberances extending between the semi-spherical halves along its surface and the whole unit is contained in a suitable shell structure. Here it would take only two protuberances and one incoming suitable actuator to ensure locking. The same would also apply to a gear-like structure contained in a suitable shell and locked by an actuator.

According to the invention, the penetrating tip of the actuator contacts the surfaces of the protuberances defining the penetrated concavity, but does not contact the surface of the rounded member defining the bottom of the concavity. But after extended use, the protuberances may show significant wear, allowing the actuator tip to touch said surface, To

prevent such an incomplete locking, it may be useful to add a depression into the surface of the rounded member at each locking site which would in conjunction with the protuberances result in a kind of sine wave surface. This could prolong the use of the joint mechanism before the actuator tip touches the bottom of the concavity.

The configuration of protuberances preferably form triangular or square patterns, or the protuberances could define a combination of square and triangular patterns on said rounded member.

The actuator may have multiple tips disposed to penetrate simultaneously more than one concavity. Furthermore, the actuator or its head defined by the tip may have a floating seating to enable self-adjustment.

In a preferred version, the actuator can be biased, such as by spring loading, such that the actuator tip is prevented from falling out of contact with the protuberance or cluster of protuberances, when the actuator is not in the locking position.

It is also within the invention to use an actuator, the configuration of this actuator being similar to that of the rounded member including the protuberances.

The joint mechanism according to the invention will find application in different fields, for example in the field of prosthetics (defining an orthotic or prosthetic joint), wheelchairs (head rest joint) and for example in connection with a sunshade umbrella.

BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the invention will become apparent from the detailed description of an embodiment thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein

FIG. **1**—is a perspective, partly sectional view showing a rounded member defined by a ball, an actuator and connection housing assembled;

FIG. **2**—a perspective view showing a ball and pin-type actuator in simplified form;

FIG. **3**—a side view of a ball having its surface divided into triangles to establish a pattern of protuberances:

FIG. **4**—a side view of the ball of FIG. **3**, with protuberances positioned at the apices of the triangles of FIG. **3**;

FIG. **5**—a schematic cross-section showing a pin having its shank positioned in a radial bore formed in the ball with its head defining a protuberance in contact with a spherical actuator end having a minimum clearance from the surface of the ball;

FIG. **6**—a cross-section according to FIG. **5** showing a maximum distance between actuator end and ball surface;

FIG. **7**—a side view of the pin according to FIGS. **5** and **6** and

FIG. **8**—a cross-section of the rounded tip of the actuator having a central indentation in its end.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

With reference to FIG. **1**, the joint mechanism comprises a spherical member or ball **1** connected with at shank **2**. The surface **3** of the ball **1** is formed with areas of triangular patterns a and square patterns b of protuberances **4**. The spacing, area and size of the triangular patterns a is consistent, and the same is true of the square patterns b. The size and spacing of each protuberance **4** in each pattern is mainly consistent.

The joint mechanism further comprises an actuator **5** having a rounded or spherical tip **6** (FIG. **2** and FIGS. **5** to **7**). The actuator **5** or its tip **6** can be advanced or retracted, for example by a bolt (not shown), to penetrate or withdraw from a concavity **7** defined by a pattern a, b of three or four protuberances **4**.

According to FIGS. **5** to **7**, the protuberances **4** could be defined by the heads of pins **8** received and retained in radial bores **9** formed in the ball **1**.

To hold ball **1** and actuator **5** together and to allow these parts to change relative orientation when the actuator tip **6** is retracted, there is provided an outer shell **12** (FIG. **1**) and an internal shell liner **13** formed of a resilient material. In the outer and inner shell **12**, **13** there is an upper slot **14**; the shank **2** of the ball **1** fits into the slot **14** which extends across the complete upper surface of said shells to thereby permit maximum rotation.

The protuberances **4**, actuator tip **6** and patterns a, b being dimensioned so that the tip **6** can penetrate the concavity **7** of each pattern a, b and simultaneously contacts all of the protuberances **4** of the pattern that it penetrates but remains spaced from the surface **3** of the ball **1** at full penetration. Details are shown in FIGS. **5** and **6**:

c=radial height of protuberance **4** defined by the pin head

d=radial length of bore **9**

e=minimum clear distance between tip **6** and ball surface **3**

f=maximum clear distance between tip **6** and ball surface **3**

g length of pin **8** plus its head

h slope angle of protuberance **4**

i diameter of pin **8**

j angle between bottom of the pin head and ball surface **3**.

A suitable set of dimensions for the components of FIGS. **5** to **7** is provided in Table 1, for recommended maximum and minimum pin separation for an overall pattern of 162 pins.

TABLE 1

Ball ø:			1.043" (26,5 mm)	
pin ø:			0.142" (3,6 mm)	
actuator tip ø:			2.250" (6,4 mm)	
Dimensions:				
c = 0.043"	(1,1 mm)		g = 0.236"	(6 mm)
d = 0.23"	(5,8 mm)		h = 43°	
e = 0.015"	(0,4 mm)		i = 0.063"	(1,6 mm)
f = 0.023"	(0,6 mm)		j = 6.0°	

In an optional feature of the invention, the spherical tip **6** of the actuator **5** is formed to provide an indentation **10** in its end (FIG. **8**). The indentation **10** may be configured to closely conform to the peak **11** of each protuberance **4**, so that if the tip **6** contacts a peak **11** straight on, the two parts will lock up. This adds as many locking positions as protuberances **4** are formed an the ball surface.

To create a firmer locking position it may be advantageous that said peak **11** contacts the lateral area **10***a* of the penetrated indentation **10** only, but remains spaced from the bottom **10***b* of the indentation **10** at full penetration.

While the invention has been described in terms of a single preferred embodiment, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the appended claims.

What is claimed is:

1. An angularly adjustable releasably lockable joint mechanism for rigidly joining first and second parts at a selected orientation, said mechanism comprising:

a first member having a plurality of patterns of spaced apart protuberances covering at least a part of a surface of the first member, each of the plurality of patterns of the spaced apart protuberances forming a concavity therebetween;

a second member having a disengageable actuator, the disengageable actuator having at least one tip and being operative to advance the at least one tip to lock up with the first member by penetrating at least one concavity of the first member or to retract the at least one tip to disengage from the first member, the actuator being connected with the second part; and

a housing which retracts the at least one tip with respect to the first member such that the first and second members are disengaged and the first and second parts change relative orientation when the at least one tip is retracted, wherein

the protuberances, the actuator tip, and the patterns of the protuberances are dimensioned so that the at least one tip penetrates the concavity of each pattern and simultaneously contacts the protuberances of the pattern, whereby the tip and the pattern of protuberances lock together, and

wherein one of the at least one tip is spaced apart from the surface of the first member at one concavity in both an engaged position and a disengaged position.

2. The joint mechanism as defined in claim **1**, wherein at least another of the at least one tip is spaced apart from the surface of the first member at another concavity in both the engaged position and the disengaged position.

3. The joint mechanism as defined in claim **1**, further comprising means for preventing movement of yaw, pitch and roll between the first member and the second member.

4. The joint mechanism as defined in claim **3**, wherein the preventing means includes at least one locking pin on the second member, the at least one locking pin being spring biased to engage with the protuberances on the first member.

5. An angularly adjustable releasably lockable joint mechanism for rigidly joining first and second parts at a selected orientation, said mechanism comprising:

a first member having a plurality of concavities on a surface of the first member and being secured to the first part, the first member includes a plurality of patterns of spaced apart protuberances covering at least a part of a surface of the first member, the protuberances of each pattern forming a concavity therebetween;

a second member having a disengageable actuator extending therethrough, the disengageable actuator having a tip and being operative to advance the tip to lock up with the first member by penetrating a concavity of the first member or to retract the tip to disengage it from the first member, the actuator being connected with the second part;

at least one locking pin having a moveable tip, the at least one locking pin being spaced apart from the disengageable actuator and being spring biased so that the locking pin tip engages the first member, the at least one locking pin preventing yaw, pitch, and roll movement between the first member and the second member; and

means for holding the parts, the first member, and the actuator together, the means allowing the parts to change relative orientation when the at least two tips are retracted, wherein

the protuberances, the at least two tips and the patterns of the protuberances are dimensioned so that the at least two tips penetrate the at least two concavities and simultaneously contact the protuberances of each of the patterns, and

wherein the moveable tip is spaced apart from the surface of the first member in both an engaged position and a disengaged position.

6. The joint mechanism as defined in claim **5**, further comprising a clicking pin spaced apart from the locking pin, the clicking pin being spring biased toward the first member.

7. An angularly adjustable releasably lockable joint mechanism for rigidly joining first and second parts at a selected orientation, said mechanism comprising:

a first member having a plurality of concavities on a surface of the rounded member and being secured to the first part, the first member includes a plurality of patterns of spaced apart protuberances covering at least part of a surface of the first member, the protuberances of each pattern forming a concavity therebetween;

a second member having a disengageable actuator having at least one tip and being operative to advance the tip to lock up with the first member by penetrating at least one concavity of the rounded member or to retract the tip to disengage it from the rounded member, said actuator being connected with the second part;

means for preventing yaw, pitch, and roll movements between the first member and the second member; and

means for holding the parts, the first member, and the actuator together, the means allowing the parts to change relative orientation when the actuator tip is retracted,

wherein at least one of the disengageable actuator tips includes an indentation being configured and dimensioned to substantially match a peak of the protuberances so that the tip and protuberances lock together.

* * * * *